

FROM  
SWIMMING  
POOLS TO  
VACUUM  
CHAMBERS:  
HOW WE TEACH  
ASTRONAUTS  
TO SPACEWALK

ALLISON BOLINGER  
NASA JOHNSON SPACE CENTER



# WHO IS ALLISON?

# WHO IS ALLISON?

Grew up in central Ohio loving math, science, and space

- Attended Space Camp at Kennedy Space Center in 6<sup>th</sup> and 12<sup>th</sup> grade

Attended Purdue University in West Lafayette, IN

- Majored in [Aerospace Engineering](#)

Participated in the co-operative education program

- Alternated between semester at school and semester at NASA

Working at NASA for ~12 years in the Extravehicular Activities (EVA) Operations Group





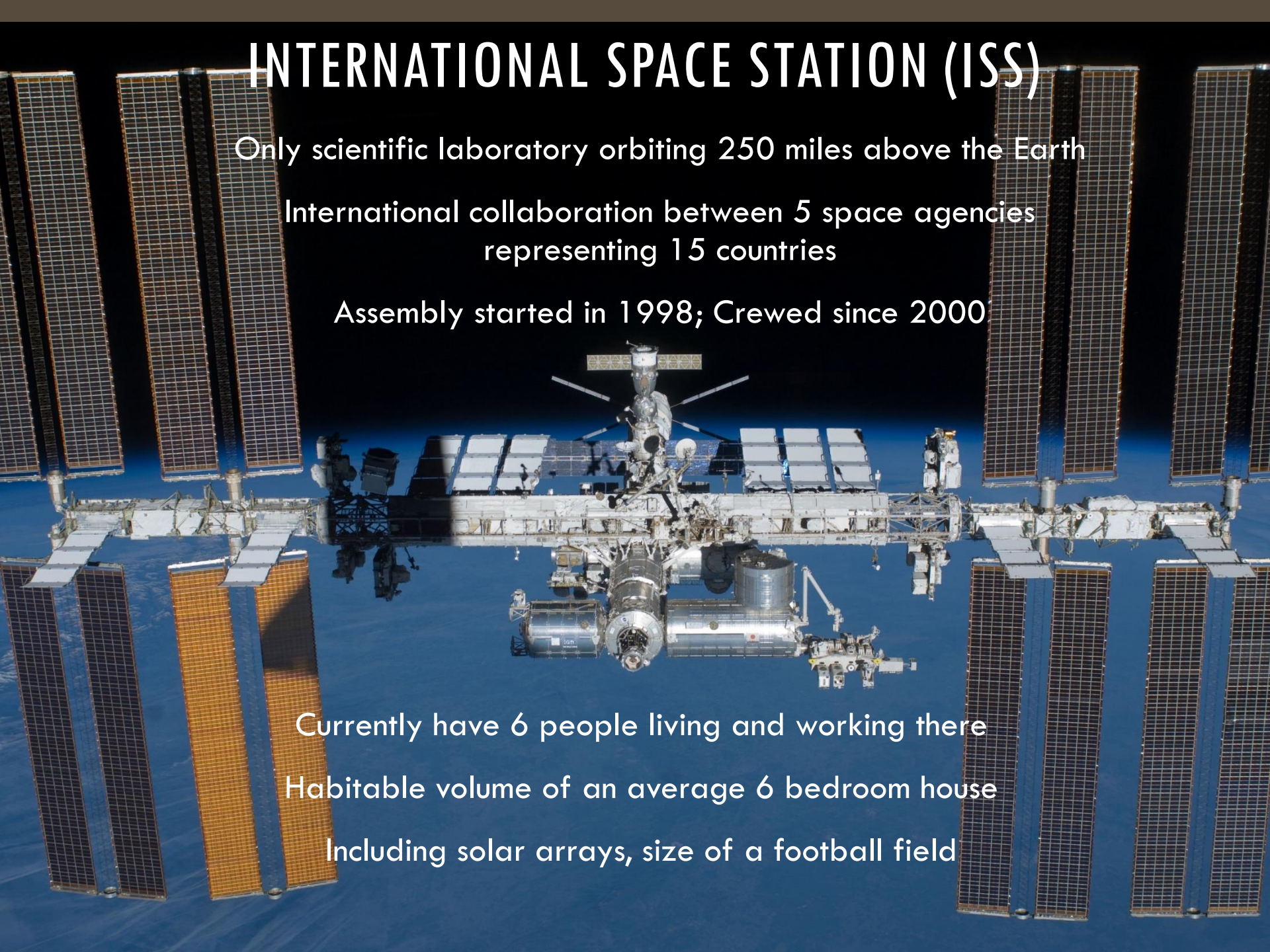
# INTERNATIONAL SPACE STATION (ISS)

Only scientific laboratory orbiting 250 miles above the Earth

International collaboration between 5 space agencies  
representing 15 countries

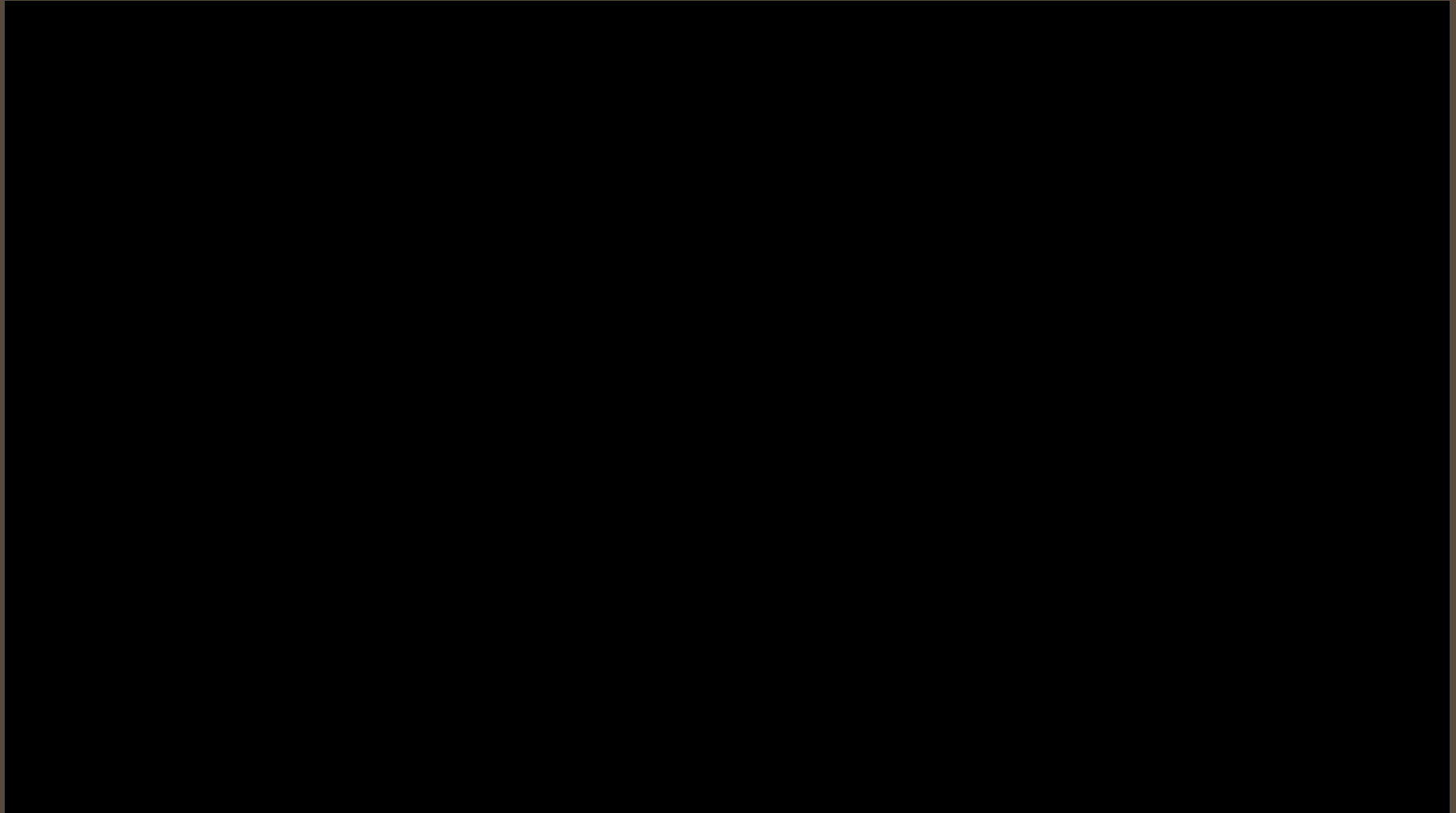
Assembly started in 1998; Crewed since 2000

Currently have 6 people living and working there  
Habitable volume of an average 6 bedroom house  
Including solar arrays, size of a football field



# HOW WE BUILT ISS

37 Space Shuttle Flights and ~150 EVAs to assemble and maintain





# EXTRAVEHICULAR ACTIVITIES (EVA)





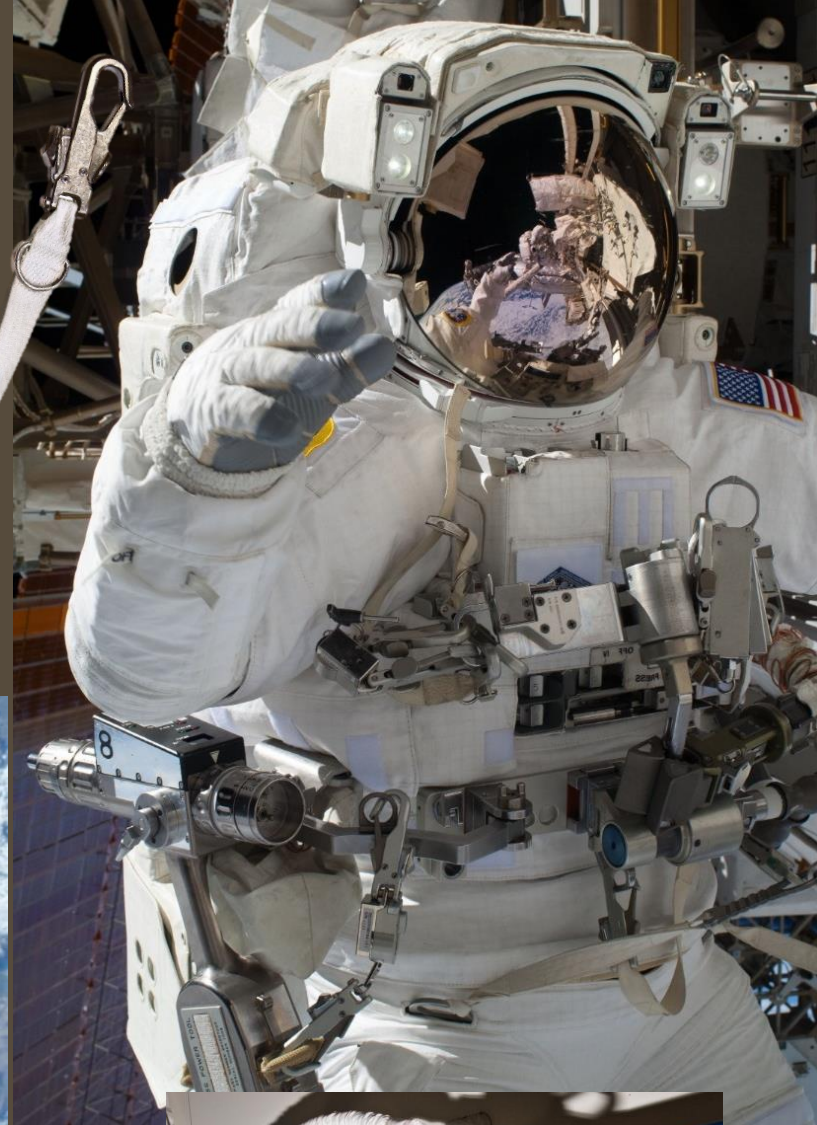
# EXTRAVEHICULAR MOBILITY UNIT (EMU)

Provides basic life support functions to protect astronauts while working in the extreme environment of space

- PLSS – Primary Life Support System, delivers oxygen to breathe and maintain suit pressure, scrubs carbon dioxide, provides battery power to keep things running
- HUT – Hard Upper Torso, fiberglass upper part of the EMU that the helmet, arms and waist attaches to
- TMG - Thermal Micrometeoroid Garment, white outer layer that provides protection to the suit bladder from thermal extremes and small micrometeoroids
- DCM – Display and Control Module, has a digital display and mechanical pressure gage to allows you to check out your suit's performance
- LCVG – Liquid Cooling and Ventilation Garment circulates water around the astronaut's body for cooling
- DIDB – Disposable In-suit Drink Bag holds 32 ounces of water to drink
- MAG – Maximum Absorbency Garment...for when you're done with the 32 ounces of water!
- Helmet lights for when it is dark and a sun visor for when it is sunny
- Radio to talk to Mission Control and your partner, also to downlink suit parameters to Mission Control

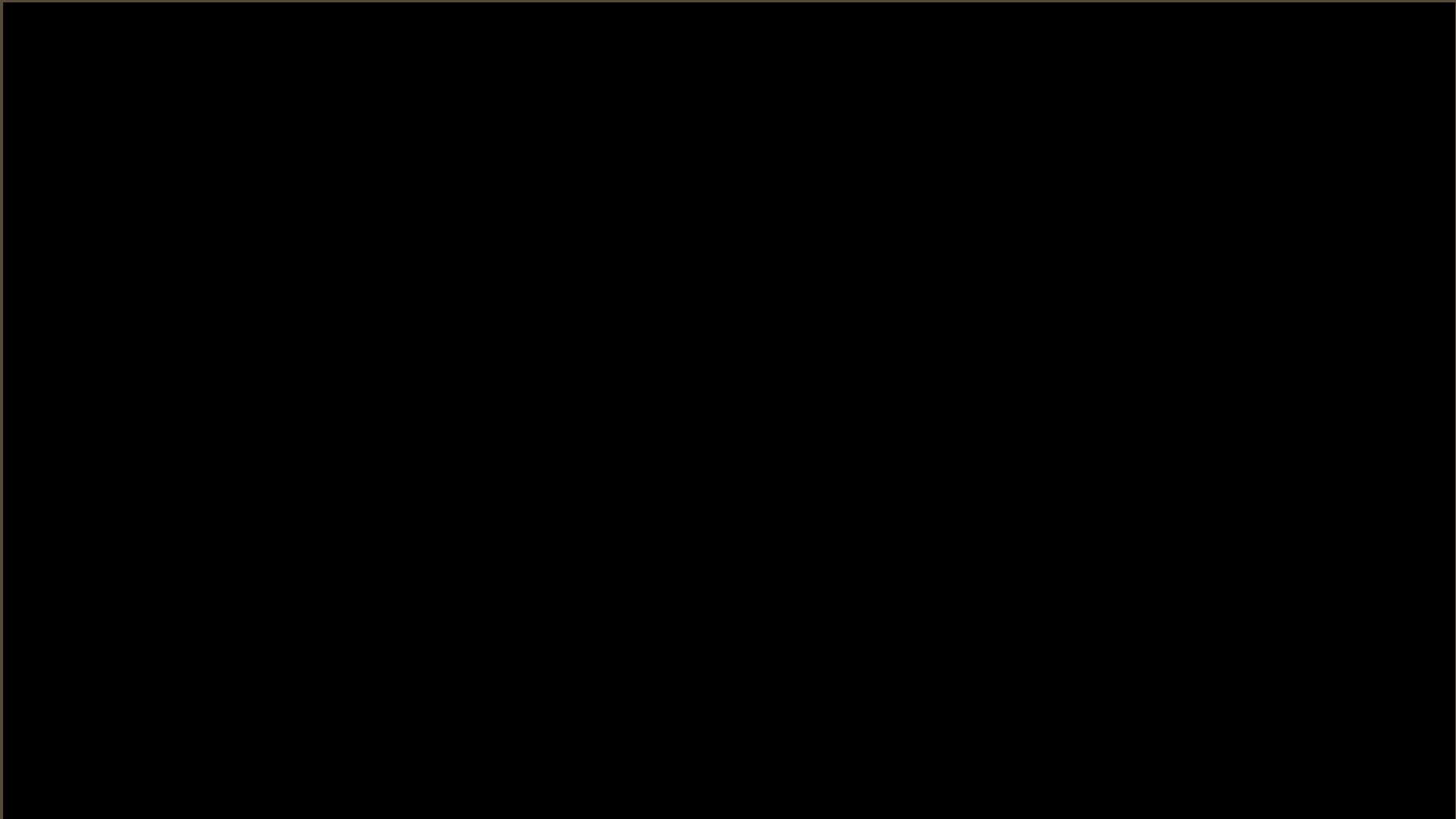




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# VIDEO FROM US EVA 30



# HOW TO TRAIN TO WORK IN SPACE

New astronauts learn the basics of EVA including how the EMU works and how to perform basic tasks during an EVA

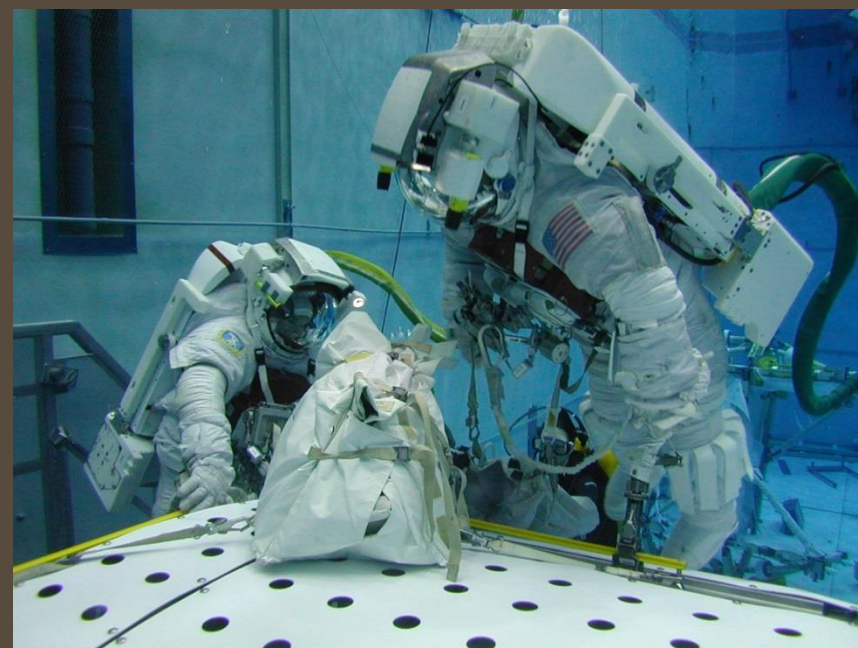
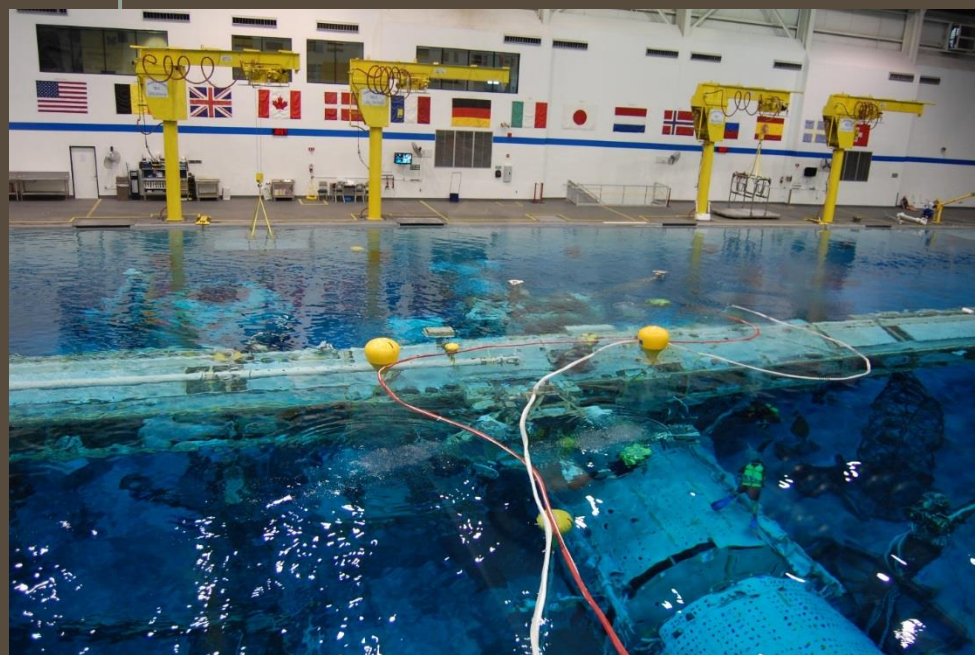
Once assigned to an ISS Increment, astronauts spend ~22 months learning all about life on the ISS, including more in depth EVA knowledge

EVA Training facilities include:

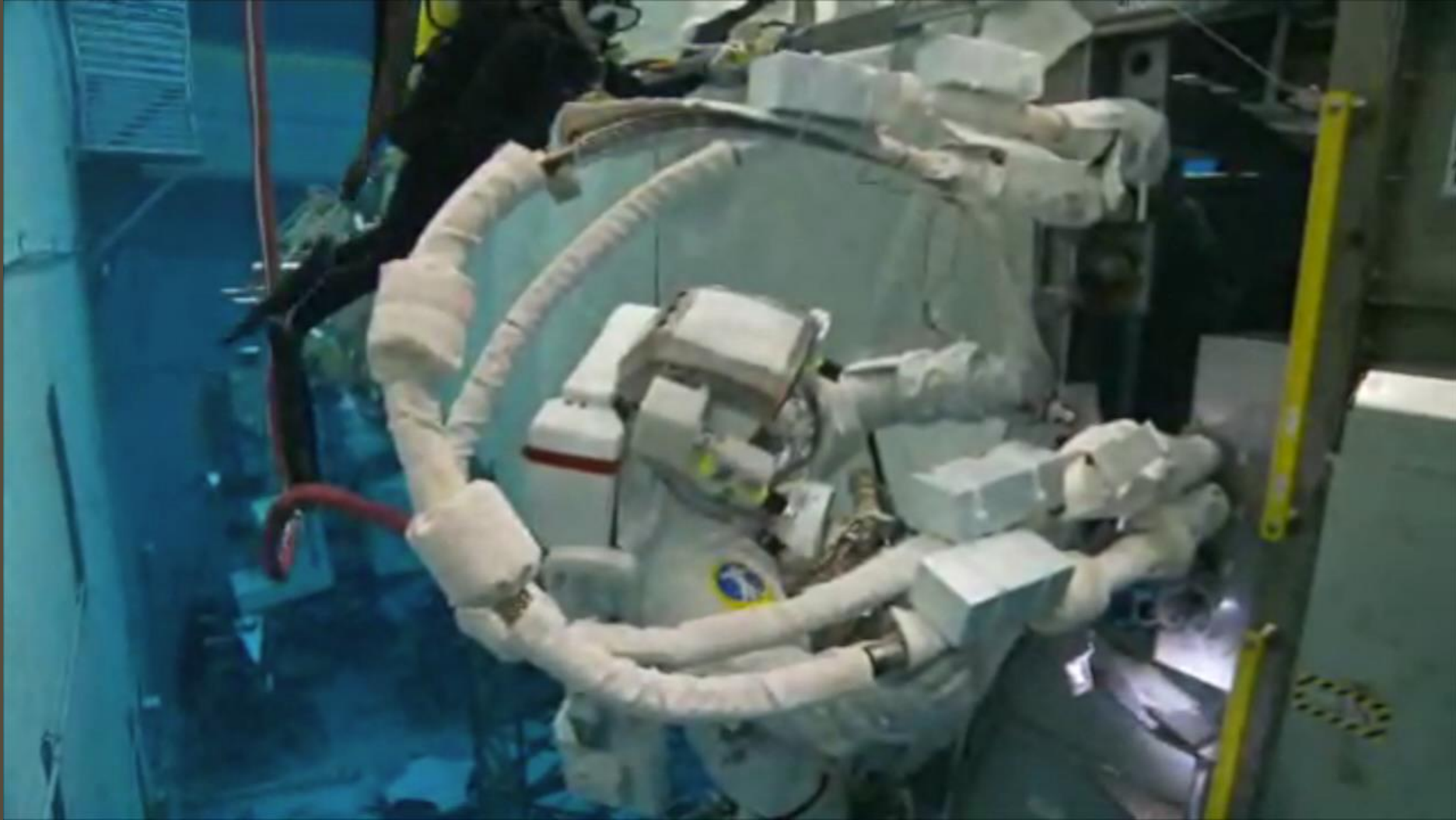
- Neutral Buoyancy Lab (NBL)
- Virtual Reality (VR) Lab
- Space Station Airlock Test Article (SSATA) Vacuum Chamber
- Space Vehicle Mock-up Facility (SVMF)
  - Airlock
  - Partial Gravity Trainer (POGO)
  - Active Response Gravity Offload System (ARGOS)



# NEUTRAL BUOYANCY LAB (NBL)



# NEUTRAL BUOYANCY LAB (NBL)





# VIRTUAL REALITY (VR) LAB



# VIRTUAL REALITY (VR) LAB





# SPACE STATION AIRLOCK TEST ARTICLE (SSATA) VACUUM CHAMBER





# SPACE VEHICLE MOCK-UP FACILITY (SVMF)





# SVMF AIRLOCK





# ISS AIRLOCK



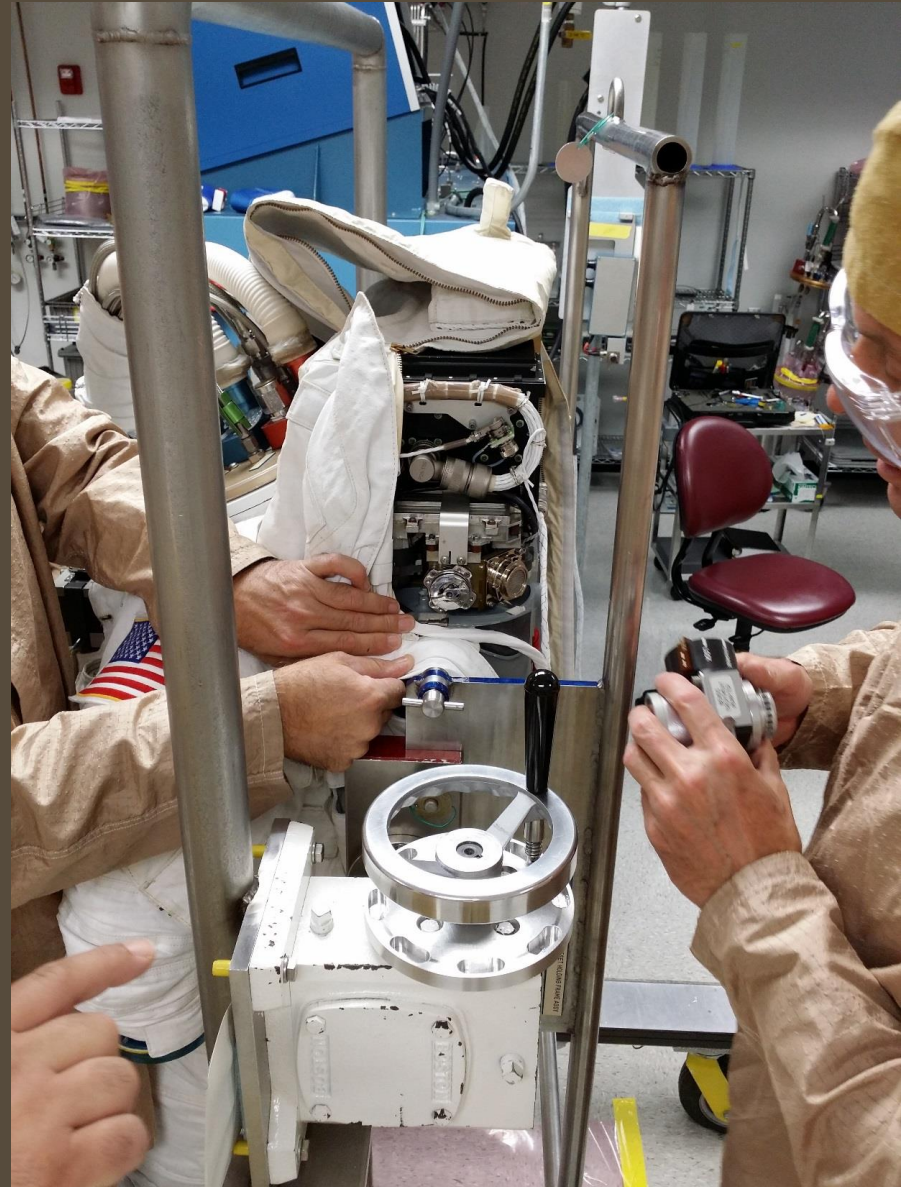


# PARTIAL GRAVITY TRAINER (POGO) ACTIVE RESPONSE GRAVITY OFFLOAD SYSTEM (ARGOS)





# CLASS I LAB





# MISSION CONTROL

**FCR-1**

SPARTAN

RIO

BME

TOPO

ADCO

SURGEON

CRONUS

**Flight Director**

**CapCom**

ROBO

OSO

ETHOS

**EVA Officer**

**EVA  
MPSR**

EVA Task

EVA Systems

**EVA  
MER**

Structures  
and  
Mechanisms

Active  
and  
Passive  
Thermal

EVA –  
Boeing  
Support

EVA  
Tools

EMU  
MER



# MAJORS IN THE EVA OPERATIONS GROUP

